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Indian Standard

SOLID STATE INVERTERS RUN FROM STORAGE BATTERIES – SPECIFICATION

UDC 621·314·57-835

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Price Group 2

Power Electronics Sectional Committee, ETD 31

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Power Electronics Sectional Committee had been approved by the Electrotechnical Division Council.

This Indian Standard has been prepared to lay down the technical requirements of solid state inverters run from a storage batteries (dc source).

The inverters run from storage batteries are used to convert ac from dc such that short time failure of the supply is substituted by these inverters to maintain continuity.

While preparing this standard, assistance has been taken from IRS : S 58-1982 'Specification for inverters for railway signalling (tentative)' issued by Ministry of Railways.

Some inverters include battery charging arrangements. This standard, at present, does not cover requirements on this aspect and the users may take care of it. A separate standard on battery chargers is under preparation.

This specification does not cover inverters for use with induction motors.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SOLID STATE INVERTERS RUN FROM STORAGE BATTERIES – SPECIFICATION

1 SCOPE

1.1 This standard lays down the requirements and tests for solid state inverters run from storage batteries (dc source).

1.2 For some specific applications, additional requirements may be required. Such additional requirements may be agreed between the manufacturer and the user.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjunct to this standard.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1885 (Part 27) : 1985 shall apply.

4 GENERAL REQUIREMENTS

4.1 The inverters shall use solid state devices for producing the required ac output from dc input supply. These devices shall conform to the requirements of relevant Indian Standards, wherever these exist. They shall be suitably protected against surges.

4.2 The inverters shall be natural/forced air cooled and shall be suitable for indoor use.

4.3 The lay out of the components and wiring shall be such that all parts of the inverters are easily accessible for inspection. maintenance and repairs

4.4 All cables and wires used for wiring shall conform to IS 694 : 1977 and shall be neatly secured in position and adequately supported. Aluminium wires shall not be used for internal wiring. The size of the wires shall be such that the current density does not exceed 3 amperes/mm^2. The colour scheme employed for wiring shall conform to normal conversion and shall be shown in the manufacturers's instruction manual.

4.5 All connections shall be either soldered or made through crimped eyelets and shall be numbered with PVC cable markers corresponding to the numbers shown in the schematic wiring diagram (*see* **6.3**).

4.6 Phenolic/glass epoxy copper clad lamination as per IS 5921 (Part 6) : 1987 may be used for printed circuit cards. The printed circuit cards shall be specifically designed to suit the circuit used. Printed circuit cards shall have suitable plug-in arrangement and shall be suitably tropicalized.

4.7 The inverters shall be of robust construction. They shall be housed in dust protected boxes. The small metal parts such as nuts, bolts and washers and other metal parts of the inverters shall be protected against corrosion.

5 TECHNICAL REQUIREMENTS

5.1 Unless otherwise specified by the purchaser the output voltage wave form of the inverters shall be quasi-square wave.

5.2 The recommended rated input voltages of the inverters shall be 12, 24, 48 and 120 volts dc (*see* IS 12360 : 1988).

5.3 The rated output voltage of the inverters shall be either 110 V or 230 V or 240 V, ac as specified by the purchaser.

5.4 The output rating of the inverters shall be as specified by the purchaser. The inverters shall be rated for continuous output.

5.4.1 The recommended output ratings for the inverters are 100, 250, 500, 1 000 and 2 000 VA.

5.5 The inverters shall be designed for a standard frequency of 50 Hz.

5.6 If required by the purchaser, the inverters shall incorporate an arrangement for automatic change over of load from mains supply to the inverter ac output in case of failure of mains supply, with corresponding indication.

5.7 The main transformer if used shall be double wound and shall conform to Category 3 (*see* **3.1**) of IS 6297 (Part 1) : 1971 and Grade II (Table 1) of IS 6297 (Part 2) : 1973.

5.8 The inverters shall be provided with the following:

a) On/off switches conforming to IS 3854 : 1988 or IS 2628 (Part 2) : 1967 for dc input and ac output supply;

b) A pilot lamp to indicate that the ac output is on;

c) Fast acting fuses in the dc input circuit and rewirable type slide lock fuses conforming to IS 2086 : 1982 in the ac output circuits (Alternatively, suitable glass cartridge fuse may be used on ac side) ; and

d) An earthing terminal on the outside of the inverter.

5.9 If required by the purchaser, the inverter shall be provided with means for protection against the following conditions:

a) Pole reversal of dc input,

b) Under voltage of dc input, and

c) Overload of ac output.

5.9.1 In addition, if required by the user the inverters of output ratings of 500 VA and above may be provided with visual and audible indications for conditions (a) to (c) above.

5.10 The inverters shall be provided with output voltage and current meters conforming to IS 2419 : 1979 and of an accuracy class not inferior to 2·5 in accordance with IS 1248 : 1983 if required by the purchaser.

5.11 The inverters shall be suitable for operation over an ambient temperature range of – 10°C to + 45°C (*see* IS 9676 : 1980/IS 10580 : 1983).

6 MARKING

6.1 Each inverter shall be provided with a rating plate attached outside at a conspicuous position. The rating plate shall be clearly and indelibly marked with the following information:

a) Indication of the source of manufacturer.

b) Reference to this standard, for example Ref ISS..............;

c) Rated dc input voltage;

d) Rated VA;

e) Rated frequency;

f) Rated ac output voltage; and

g) Year of manufacturer.

6.1.1 The solid state inverters may also be marked with the ISI Certification Mark. The details for the scheme may be obtained from the Bureau of Indian Standard.

6.2 The nomenclature of various switches, indicators, fuses and terminals shall be clearly and indelibly marked.

6.3 A schematic circuit/block diagram of the inverter on an anodized/engraved plate shall be attached at a convenient place, inside or outside the inverter housing.

6.4 The manufacturer shall supply with each inverter, a manual giving information which will cover the following:

a) Guaranteed performance data, technical and other particulars of the inverter;

b) Schematic wiring diagram of connection showing components;

c) General mounting arrangement of various components;

d) Technical particulars and specifications of various components: and

e) Any other information which the manufacturer may like to give at the discretion of the purchaser.

7 TESTS AND PERFORMANCE REQUIREMENTS

7.1 Unless otherwise specified, all tests shall be carried out at ambient atmospheric conditions.

7.1.1 Suitable voltmeters and ammeters shall be used in the tests. The meters shall be of an accuracy class not inferior to 1·0 in accordance with IS 1248 : 1983.

7.2 Type Tests

7.2.1 The following shall constitute type tests and shall be carried out in the sequence given below:

a) Visual inspection (**7.5**),

b) High voltage test (**7.6**),

c) Insulation resistance test (**7.7**),

d) No-load test (**7.8**),

e) Output test (**7.9**),

f) Climatic tests (when specified by the purchaser (**7.10**), and

g) Harmonic contents test (when specified by the purchaser) (**7.11**).

NOTE — Proposals are invited for inclusion, if necessary for details of radio frequency interference test, temperature rise test and life test with their requirements.

7.3 Acceptance Tests

The following shall constitute acceptance tests:

a) Visual inspection (**7.5**),

b) High voltage test (**7.6**),

c) Insulation resistance test (**7.7**),

d) No-load test (**7.8**) and

e) Output test (**7.9**).

7.4 Routine Tests

The following shall constitute routine tests:

a) Visual inspection (**7.5**),
b) High voltage test (**7.6**),
c) Insulation resistance test (**7.7**), and
d) No-load test (**7.8**).

7.5 Visual Inspection

The inverters shall be visually inspected for compliance with requirements given in **4, 5** and **6** of this standard.

7.6 High Voltage Test

With the electronic components by passed, the inverters shall withstand for one minute a test voltage of 1 500 V rms applied between all parts of electric circuit and other metallic parts insulated there from without puncture and arcing. The test voltage shall be alternating of approximately sinusoidal wave form and of any frequency between 40 and 60 Hz.

7.7 Insulation Resistance Test

This test shall be made at a voltage of 500 V dc. The insulation resistance shall be measured between individual insulated circuits and earth with all electronic-circuits short circuited. The value of insulation resistance shall not be less than 10 megohms. When the test is repeated after climatic tests, the value shall not be less than 5 megohms.

7.8 No-load Test

7.8.1 *No-Load dc Current*

At rated voltage, the idle current shall not exceed 10 percent of the full load current for inverters of output rating of 250 VA or less. For inverters of higher output ratings, the idle current shall not exceed 5 percent of the full load current.

7.8.2 *Output Voltage*

The ac output voltage on no-load shall be with in ±5 percent of the rated value over +10 percent and −20 percent variation of the rated dc input voltage.

7.9 Output Test

7.9.1 *Voltage Regulation*

The variation in output voltage from no-load to full load expressed as a percentages of the no-load voltage shall not exceed ±5 percent over +10 percent and −20 percent variation of the rated dc input voltage.

7.9.2 *Frequency*

The frequency of the output voltage shall be 50 Hz ± 3 percent. This frequency stability shall be available over the entire working range of the inverter.

7.9.3 *Efficiency*

The efficiency of the inverters only while delivering the rated output to a load of power factor 0·8 shall not be less than:

a) 85 percent for output ratings above 250 VA, and
b) 80 percent for output rating of 250 VA and less.

7.9.4 The overload capacity of the inverter shall be as agreed to between the supplier and the purchaser.

7.10 Climatic Tests

7.10.1 The inverters shall be subjected to the tests as given in Table 1 to determine suitability for use under the climatic conditions specified in the tests.

Table 1 Climatic Tests

Test	Degree of Severity	Specification
Dry heat	70 ± 2°C for 6h	IS 9000 (Part 3) : 1972
Damp heat (cyclic) test	1 cycles (variant 1) at 55°C	IS 9000 (Part 5/ Sec 2) : 1981
Cold test	—10°C for 2 h	IS 9000 (Part 2) : 1977

NOTE — In damp heat (cyclic) test if purchaser requirement is for higher number of cycles and different temperature, the same shall be mutually agreed upon by the purchaser and the supplier subject to requirements specified in IS 9000 (Part 5/ Sec 2) : 1981.

7.10.2 The inverters shall be checked for conformity with the requirements given in **7.8.2, 7.9.1** and **7.9.2** of this standard.

7.10.3 At the end of conditioning period the inverter shall be removed from the test chamber and allowed to remain under ambient atmospheric conditions for recovery for not less than one hour and not more than two hours.

7.10.4 At the end of each test and after recovery, the inverter shall be visually inspected. There shall be no signs of any apparent damage or determination. The inverters shall then satisfy the requirements of **7.7, 7.8** and **7.9** of this standard.

7.11 Harmonic Contents

If required by the purchaser the harmonics in the output supply of the converter shall not exceed the values specified below:

Total harmonics …… 5 percent
Single harmonics .. … 3 percent

8 PACKING

The inverters shall be so packed as to permit convenient handling and to protect against loss or damage during transit and storage.

9 INFORMATION TO BE SUPPLIED BY THE PURCHASER

9.1 The purchaser shall provide the following information about the intended inverter:

a) Drawing and dimentsions, if any;

b) Rated input voltage (**5.2**);

c) Rated output Voltage (**5.3**);

d) Rated output VA (**5.4**);

e) Whether output voltage and current meters required (**5.10**);

f) Whether autmomatic change of load from mains supply to supply required (**5.6**);

g) Type of load for which the inverter is to be used; and

h) Any other requirements.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
694 : 1977	PVC insulated cables for working voltages upto and including 1100 V (*second revision*)
1248 : 1983	Direct acting indicating analogue electrical measuring instruments and their accessories
1885 (Part 27): 1985	Electrotechnical vocabulary : Part 27 Power electronics (*first revision*)
2086 : 1982	Carriers and bases used in the rewirable type electric fuses upto 650 volts (*second revision*)
2419 : 1979	Dimensions for panel mounted indicating and recording electrical instruments (*first revision*)
2628 (Part 1) : 1964	Rotary water switches (low current rating) : Part 1 Tests and general requirements
2628 (Part 2) : 1967	Rotary water switches (low current rating) : Part 2 Rotary wafer switches with central mounting
3854 : 1988	Switches for domestic and similar purposes (*first revision*)
5921 (Part 6) : 1987	Metal clad base materials for printed circuits for use in electronic and telecommunication equipment : Part 6 Epoxide woven glass fabric copper-clad laminated sheet general purpose grade
6297 (Part 1) : 1971	Transformers and inductors (power, audio, pulse and switching) for electronic equipment : Part 1 General requirements and tests
6297 (Part 2) : 1973	Transformers and inductors (Power, audio, pulse and switching) for electronic equipment : Part 2 Power transformers
9000 (Part 2) : 1977	Basic environmental testing procedures for electronic and electrical items: Part 2 Cold test
9000 (Part 3) : 1977	Basic environmental testing procedures for electronic and electrical items : Part 3 Dry heat test
9000 (Part 5/ Sec 2) : 1981	Basic environmental testing procedure for electronic and electrical items : Part 5 Damp heat (cyclic) test, Section 2 12 + 12 h cycle
9676 : 1980	Reference ambient temperature for electrical equipment
10580 : 1983	Service conditions for electrical equipment
12360 : 1988	Voltage bands for electrical installations including preferred voltages and frequency

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